Notes For Forest Managers

Missouri Department of Conservation

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Diameter Growth Rates for Tree Species of Missouri Ozark Forests

Tree diameter growth differs among species, among trees of different crown and size classes, and among stands of different stocking levels. The Missouri Ozark Forest Ecosystem Project (MOFEP) provided an opportunity to quantify diameter growth in Missouri Ozark forests. We summarize diameter growth of trees ≥4.5 inches diameter at breast height (d.b.h.) by stands of different stocking levels, by trees of different crown classes, by species and by size classes. Diameter growth of surviving trees was monitored during a seven year period from 1991-1998.

Average diameter growth for all species combined was approximately 0.10 inches per season. Although stand density has been shown to affect diameter growth, growth rates during the measurement period at MOFEP were nearly as high in overstocked stands as in fully stocked stands (Figure 1). On average, diameters of canopy dominants grew 1.3 times faster than codominant trees, two times faster than intermediate trees, and more than three times faster than suppressed trees (Figure 2). Of the nine most abundant woody species at MOFEP (Figure 3), scarlet oaks in the dominant crown class were the fastest growing (over 0.20 inches per season), followed by dominant white oaks and black oaks (each approximately 0.15 inches per season). Dominant post oaks, shortleaf pines, hickories and blackgums grew more slowly (from 0.07 to 0.10 inches per season). Although there were exceptions, large poles, and small and large saw timber grew faster than small trees of the same species and crown class (Table 1).

Differences in diameter growth among ecological landtypes and soil map units were minor compared to those explained by crown class and species. This was not too surprising because different ecological landtypes and soil map units generally reflect site quality differences. Site quality is more likely to affect tree height than diameter growth (Oliver and Larson, 1996). It is for this reason that site index, the relation between tree height and age, is used as an indicator of site quality rather than diameter growth (Husch et al., 1982). We also compared diameter growth of trees in the MOFEP study to those in the Mark Twain National Forest (Shifley and Smith, 1982), and to those in forests of Illinois and Indiana (Smith and Shifley, 1984) and found diameter growth rates to be similar.

Diameter growth rates summarized in Table 1 can be used as a guide for estimating growth of individual trees in mature stands throughout the Ozarks. For example, dominant 12-inch d.b.h. white oaks in a mature stand can be expected to grow an average of 0.16 inches d.b.h. per growing season while 5-inch d.b.h. codominant white oaks may only grow 0.08 inches per growing season (see Table 1).

ABSTRACT

Tree diameter growth was monitored for seven years in Missouri Ozark forests. Diameter growth was associated with canopy position and species. Dominant scarlet oak grew fastest (0.21 in/yr); however, white oak basal area increased twice as much as other species because of moderate growth, low mortality and high recruitment of new

Table 1. Mean annual diameter growth (inches d.b.h.) by species, crown class, and size class for the nine most abundant woody species on MOFEP sites.

Species	Crown Class	# of Trees	Small Trees (4.5-5.9")	Small Poles (6.0-8.4")	Large Poles (8.5-10.9")	Small Saw Timber (11.0-13.9")	Large Saw Timber (14"+)	Overall Average
White Oak	Dominant	806	--	0.137	0.149	0.163	0.141	0.146
	Codominant	3217	0.084	0.113	0.141	0.146	0.122	0.130
	Intermediate	4674	0.064	0.095	0.114	0.117	0.086	0.085
	Suppressed	1982	0.051	0.078	0.085	0.092	--	0.062
Black Oak	Dominant	1784	--	0.163	0.176	0.159	0.148	0.152
	Codominant	4244	0.102	0.117	0.136	0.138	0.134	0.133
	Intermediate	1481	0.072	0.094	0.104	0.099	0.090	0.090
	Suppressed	174	0.058	0.077	0.053	--	--	0.067
Scarlet	Dominant	1809	--	0.152	0.204	0.218	0.203	0.207
Oak	Codominant	3599	0.090	0.129	0.165	0.178	0.188	0.160
	Intermediate	1715	0.068	0.100	0.113	0.133	0.155	0.092
	Suppressed	280	0.058	0.082	0.092	--	--	0.067
Shortleaf	Dominant	1000	--	0.099	0.095	0.108	0.111	0.108
Pine	Codominant	1881	0.039	0.064	0.080	0.091	0.100	0.080
	Intermediate	956	0.022	0.046	0.046	0.058	--	0.040
	Suppressed	224	0.019	0.021	0.040	--	--	0.022
Post Oak	Dominant	324	--	0.083	0.097	0.081	0.089	0.087
	Codominant	1119	0.064	0.066	0.068	0.075	0.068	0.069
	Intermediate	896	0.031	0.042	0.045	0.038	0.035	0.038
	Suppressed	265	0.021	0.029	0.041	--	--	0.025
Pignut	Dominant	128	--	--	0.101	0.091	0.118	0.104
Hickory	Codominant	596	0.072	0.076	0.088	0.088	0.088	0.084
	Intermediate	967	0.041	0.056	0.064	0.055	--	0.050
	Suppressed	434	0.026	0.045	0.079	--	--	0.035
Mockernut	Dominant	94	--	0.075	0.086	0.081	0.107	0.091
Hickory	Codominant	533	0.054	0.066	0.066	0.073	0.072	0.067
	Intermediate	960	0.040	0.050	0.050	0.048	--	0.046
	Suppressed	446	0.031	0.031	0.041	--	--	0.032
Black	Dominant	139	--	0.092	0.081	0.093	0.098	0.093
Hickory	Codominant	649	0.058	0.060	0.064	0.068	0.082	0.066
	Intermediate	850	0.043	0.047	0.049	0.048	--	0.046
	Suppressed	357	0.026	0.040	0.048	--	--	0.032
Blackgum	Dominant	65	--	--	--	0.056	0.066	0.065
	Codominant	147	--	0.091	0.055	0.045	0.047	0.035
	Intermediate	260	0.053	0.066	0.065	0.023	0.027	0.057
	Suppressed	228	0.046	0.068	0.017	--	--	0.051

Diameter growth rate information can be used to guide thinning and harvest decisions. It can also be used to make short-term projections of stand growth. However, it is important to recognize that diameter growth rates measured in this study do not necessarily represent the maximum diameter growth potential that can occur in Ozark forests. Moreover, diameter growth rates cannot be used for completely understanding stand development.

Understanding stand development requires knowledge of total growth, in-growth (i.e., trees that have grown sufficiently large to be inventoried), and mortality of all trees of the forest. For example, moderate and high diameter growth rates of black and scarlet oak may lead to a conclusion that these species are contributing the most to basal area growth in MOFEP stands. However, these species actually had low to moderate net basal area increases during the measurement period because of high mortality (Figure 4). White oak, on the other hand, had the greatest net basal area growth because of its moderate growth rate, high ingrowth rate and low mortality (Figure 4). It appears that white oak abundance is increasing faster than black and scarlet oak in undisturbed MOFEP stands.

Stand development trends are closely related to stand age, species composition, size distributions of species and ecological landtype, as well as to the silvicultural system used. Development trends occurring prior to harvest may now be considerably different in stands that were harvested. MOFEP will provide additional opportunities to quantify tree growth and stand development under even- and uneven-age and no-harvest management and among ecological landtypes.

Summary

The average growth rate of all trees was 0.10 inches per season, but canopy dominants grew 0.15 inches per season, which was 1.3 times faster than codominant trees, two times faster than intermediate trees, and more than three times faster than suppressed trees. Scarlet oak was the fastest growing species, followed by black oak, white oak, shortleaf pine,

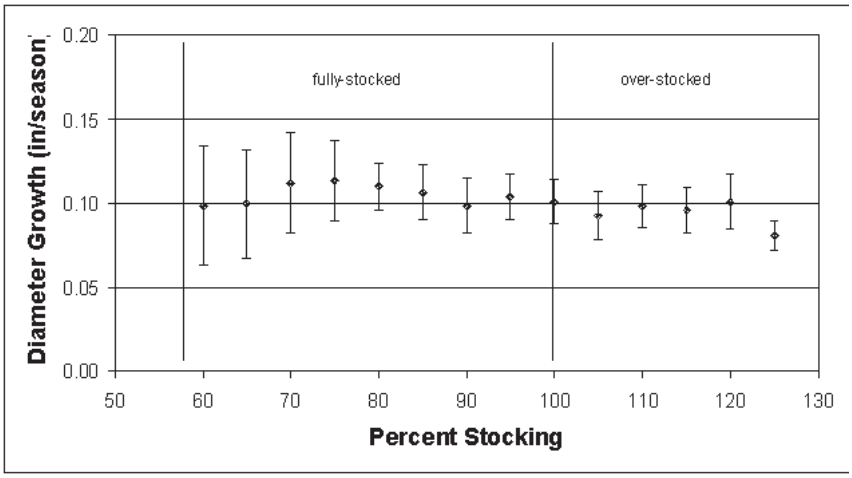

Figure 1. Diameter growth of all tree species ≥4.5 inches dbh by percent stocking. Error bars are 95% confidence intervals. Pairs of points having overlapping confidence intervals are not considered significantly different.

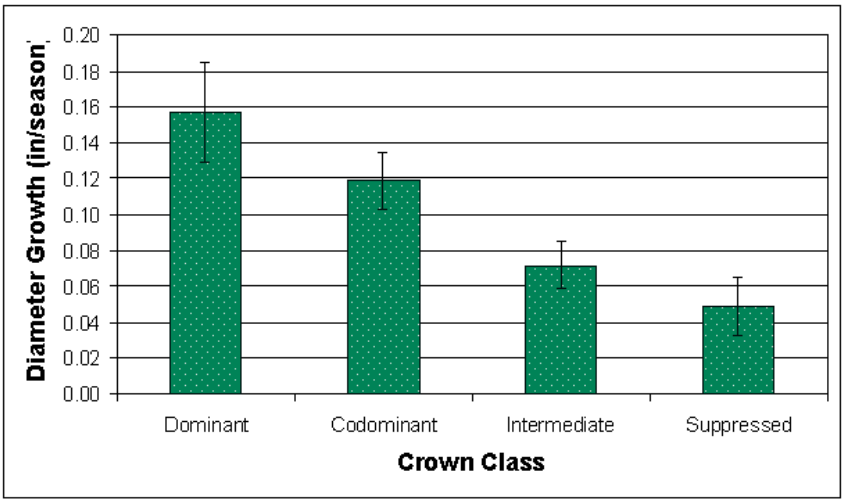

Figure 2. Diameter growth of all tree species ≥4.5 inches dbh by crown classes. Error bars are 95% confidence intervals. Pairs of overlapping confidence intervals are not considered significantly different.

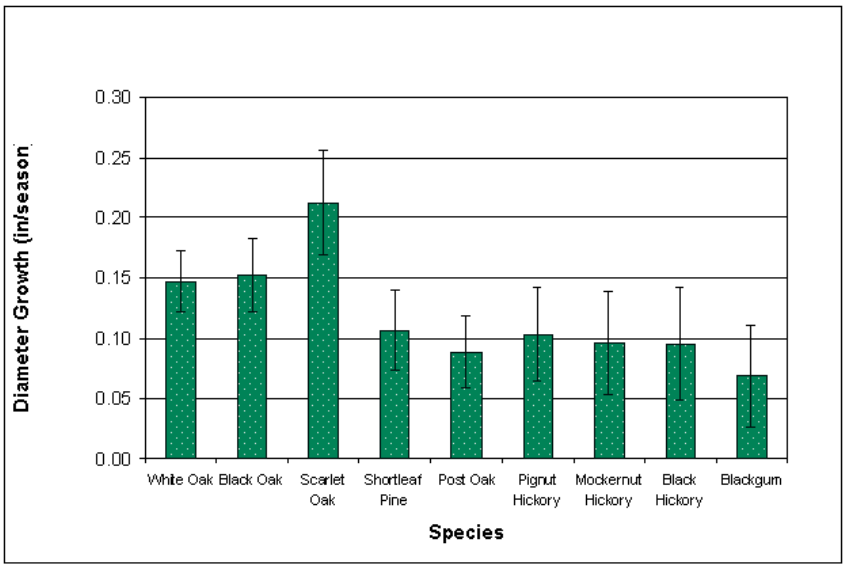

Figure 3. Diameter growth of the nine most abundant species ≥4.5 inches dbh on MOFEP sites. Bars are 95% confidence intervals. Pairs of overlapping confidence intervals are not considered significantly different.

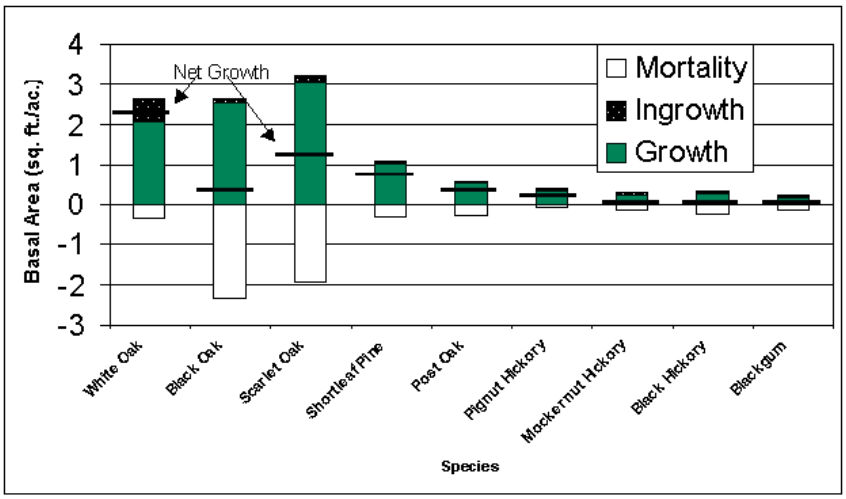

Figure 4. Total basal area growth, ingrowth, mortality and net basal area growth per acre of MOFEP trees ≥4.5 inches dbh during the measurement period 1991-1998. Black horizontal bars represent net basal area growth.

hickories, post oak and blackgum. Large poles, and small and large saw timber grew faster than small trees of the same species and crown class. Diameter growth rates did not vary significantly among soils or ecological landtypes and were similar to those elsewhere in Missouri, as well as in forests of southern Illinois and Indiana. Despite fast diameter growth rates, net basal area growth of black and scarlet oak on MOFEP is less than net basal area growth of white oak, primarily because of high mortality. Summarized diameter growth information provides foresters a guide for estimating diameter growth rates of individual trees.

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The Missouri Ozark Forest Ecosystem Project generated the data for this Note.

Invitation for Submissions

Authors are invited to submit manuscripts for Notes For Forest Manaagers. Notes should be field oriented and relevant to forest land management. Submissions may be sent to:

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